

# Clinical Characteristics Affecting the Outcome of Pneumatic Retinopexy

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**Objectives:** To review characteristics and outcomes of patients who underwent primary pneumatic retinopexy (PR) for repair of rhegmatogenous retinal detachment in a multioffice retina practice and to determine what preoperative characteristics were associated with success or failure of PR.

**Methods:** A retrospective medical record review was conducted of patients who underwent primary PR from September 2001 to March 2009. Patients with less than 6 months of follow-up were excluded. Data collected on each patient included age, sex, affected eye, preoperative visual acuity, lens status, presence of posterior vitreous detachment, presence of vitreous hemorrhage, macular status, presence of lattice degeneration, number and location of retinal breaks, clock hour extent of detachment, final visual acuity, final retinal status, number of procedures to reattach retina, and duration of follow-up.

**Results:** Two hundred thirteen patients were included. The mean age was 59.3 years and 53.5% were male. Mean follow-up was 24.6 months, and 64.8% of patients had a successful PR. Vitreous hemorrhage and retinal detachment greater than 4.5 clock hours were the 2 factors that significantly affected successful outcome ( $P = .04$  and  $.01$ , respectively). The overall mean final visual acuity was 20/40, with a mean of 20/30 in the success group and a mean of 20/60 in the failure group ( $P < .001$ ).

**Conclusions:** Pneumatic retinopexy is a treatment option for certain types of rhegmatogenous retinal detachment. In patients with vitreous hemorrhage and detachments greater than 4.5 clock hours, the success rate may be lower. Final visual acuity is better with successful reattachment with a single procedure.

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**P**NEUMATIC RETINOPEXY (PR) has become an important procedure in the treatment of rhegmatogenous retinal detachments (RDs). It was first introduced in the 1980s as an in-office procedure to repair RDs that meet certain criteria: It is generally reserved for RDs with a single retinal break, or group of breaks, no larger or further apart than 1 clock hour located in the superior 8 clock hours of the retina with media sufficiently clear to rule out additional breaks.<sup>1,2</sup> Retinal detachments with breaks greater than 1 clock hour in size, multiple breaks further than 1 clock hour apart, and proliferative vitreoretinopathy (PVR) not exceeding grade C2 have also shown favorable results compared with scleral buckling (SB), as long as the breaks are not in the lower 4 clock hours.<sup>3</sup> The procedure is performed by using either cryopexy or laser to seal the retinal breaks and injection of an air or gas bubble to tamponade the breaks until retinopexy is achieved.

Pneumatic retinopexy is advantageous because it can be performed in the office rather than in the operating room.

This eliminates the risk of sedation or general anesthesia to the patient, and the overall cost of the procedure is less. However, it is dependent on strict patient positioning for success and, therefore, is not a viable option for some patients who are unable to do so.<sup>4</sup> It also requires meticulous preoperative screening and closer postoperative follow-up. If the procedure fails, the patient generally requires another procedure, scleral buckling, vitrectomy, or both, in the operating room. The purpose of this study was to review the preoperative characteristics and outcomes of patients who underwent primary PR for repair of RD in a multisurgeon, multioffice retina practice. The aim was to determine what, if any, preoperative characteristics were significantly associated with success or failure of PR. These failures were then further examined to determine possible reasons why these characteristics led to a failed PR.

## METHODS

Institutional review board approval was obtained from Ingalls Hospital, Harvey, Illinois. A retrospective medical record review was per-

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**Table 1. Patient Demographics<sup>a</sup>**

	No. (%)
Age, y, mean (SD)	59.3 (8.0)
Sex	
M	114 (53.5)
F	99 (46.5)
Phakic	158 (74.2)
Pseudophakic	55 (25.8)
Posterior vitreous detachment	135 (63.4)
Vitreous hemorrhage	24 (11.3)
Lattice degeneration	35 (16.4)
Macula off	76 (35.7)
No. of breaks, mean (SD) [range]	1.23 (0.17) [1-4]
Clock hours of retinal detachment, mean (SD) [range]	3.45 (0.46) [1-12]

<sup>a</sup>Demographics of patients on presentation of retinal detachment. Age, sex, lens status, presence of vitreous detachment, vitreous hemorrhage, lattice degeneration, status of macula, number of break(s), and extent of retinal detachment were evaluated.

formed on all patients who underwent primary PR for RD from September 2001 to March 2009 in a multioffice, multisurgeon, retina-only practice. The decision for proceeding with PR was similar to the guidelines described earlier.<sup>2</sup> All retinal breaks were in the upper 8 clock hours of the retina. The majority of breaks were within 1 clock hour, with a small number of patients having breaks greater than 1 clock hour apart. Patients with less than 6 months of follow-up were excluded. New retinal tear or RD after the initial 6-month follow-up period was considered a new independent event.

Data collected on each patient included age, sex, affected eye, preoperative visual acuity (VA), lens status, presence or absence of posterior vitreous detachment (PVD), presence or absence of vitreous hemorrhage (VH), macular status, presence or absence of lattice degeneration, number and location of retinal breaks, extent of RD in clock hours, final recorded VA, final retinal status, number of procedures to reattach retina, and duration of follow-up. Snellen VA measurements were converted to logMAR equivalent for statistical purposes.

Statistical analysis was performed using SPSS for Microsoft Windows (version 16; SPSS, Chicago, Illinois). The Mann-Whitney test was performed to compare independent groups with respect to noncategorical variables. The  $\chi^2$  test of association or Fisher exact test was used to compare independent groups with respect to percentages. The Fisher exact test was used if the expected frequencies were too small to permit use of the  $\chi^2$  test. A .05 significance level was used for all statistical tests and no 1-sided tests were done.

## RESULTS

### PATIENT DEMOGRAPHICS

Three hundred thirty-one eyes from 331 patients underwent PR from September 2001 to March 2009. Sixty-six eyes were excluded for previous vitrectomy or SB for RD or other conditions. Fifty-two eyes were excluded for inadequate follow-up (the retina was attached in 42 of these eyes at their final follow-up examination). Two hundred thirteen eyes had a primary PR with follow-up greater than 6 months and were included in the study.

The mean (SD) age was 59.3 (8.0) years (range, 22-87 years). The mean (SD) follow-up was 24.6 (3.3) months

**Table 2. Significant Characteristics Affecting Outcome<sup>a</sup>**

Characteristic	Success Rate, No./Total No. (%)	P Value
Vitreous hemorrhage	11/24 (45.8)	.04
No vitreous hemorrhage	127/189 (67.2)	
Clock hours of RD		.02
Extent of RD $\leq$ 4.5 clock hours	120/176 (68.2)	
RD >4.5 clock hours	18/37 (48.6)	

Abbreviation: RD, retinal detachment.

<sup>a</sup>Presenting clinical characteristics that had a statistically significant impact on the successful outcome of pneumatic retinopathy.

(range, 6-79 months). There were 114 men (53.5%) and 99 women (46.5%). There were 205 white (96.2%), 5 Hispanic (2.3%), and 3 African American (1.4%) patients. The RD was located in the left eye of 92 patients (43.2%) and in the right eye of 121 patients (56.8%). Fifty-five eyes (25.8%) were pseudophakic and 158 eyes (74.2%) were phakic. Twenty-four eyes (11.3%) had VH that was mild and did not obstruct the view of the retina. One hundred thirty-five eyes (63.4%) had a documented PVD. There was lattice degeneration in 35 eyes (16.4%) and the macula was off in 76 (35.7%). The mean (SD) number of retinal breaks was 1.23 (0.17) (range, 1-4 breaks) and the mean (SD) number of clock hours of RD was 3.45 (0.46) (range, 1-12 clock hours) (**Table 1**).

### OUTCOMES

Single-operation success was achieved in 138 patients (64.8%). The success rates for men and women were 64.9% and 64.6%, respectively ( $P = .97$ ). Left-eye success was 63.0% and right-eye success was 66.1% ( $P = .64$ ).

Pseudophakic eyes had a success rate of 57.1%, while phakic eyes' success rate was 67.5% ( $P = .16$ ). Eyes with a documented PVD had a 63.0% success rate vs a 67.9% success rate in eyes without a documented PVD ( $P = .46$ ). Eyes with lattice degeneration had a success rate of 57.1% compared with 66.3% in eyes without lattice degeneration ( $P = .30$ ).

Eyes with VH had a 45.8% success rate compared with a 67.2% success rate in eyes without VH ( $P = .04$ ). Macula-on RD had a success rate of 67.2% while macula-off RD had a 60.5% success rate ( $P = .33$ ).

When evaluating number of retinal breaks, eyes with 1 break had a success rate of 65.7% and those with more than 1 break had a 61.4% success rate ( $P = .59$ ). There were a small number ( $n = 15$ ) of eyes that had breaks greater than 1 clock hour apart. This group's success rate was 53.3% vs all others with a success rate of 65.7% ( $P = .34$ ).

Increasing clock hours of RD had a statistically significant negative impact on success rate ( $P = .01$ ). Retinal detachment greater than 4.5 clock hours had a 48.6% success rate, while those with 4.5 or fewer clock hours had a success rate of 68.2% ( $P = .02$ ) (**Table 2** and **Table 3**).

The mean preoperative Snellen VA was 20/100 (range, hand motions to 20/20). There was no statistically significant relationship between preoperative VA and suc-

cess of PR ( $P=.59$ ). The overall mean final VA was 20/40 (range, hand motions to 20/15). The mean VA in the success group was 20/30 (range, 20/200-20/15) and in the failure group was 20/60 (range, hand motions to 20/20) ( $P<.001$ ). One hundred seventeen patients (84.8%) in the success group achieved 20/40 or better VA, while 39 patients (52.0%) in the failure group achieved 20/40 or better ( $P<.001$ ).

Of the 75 eyes that required additional procedures, 51 eyes (68%) had a new or missed break(s) and 24 eyes (32%) had persistent or increased subretinal fluid. The mean (SD) time to fail was 14.0 (3.2) days (range, 1-55 days). The initial procedure after the failed PR was SB in 23 eyes (30.7%), pars plana vitrectomy in 31 eyes (41.3%), and combined SB/pars plana vitrectomy in 19 eyes (25.3%). Additionally, 1 eye (1.3%) underwent a second PR and 1 eye (1.3%) underwent laser retinopexy for a new asymptomatic inferior RD. The average number of additional procedures was 1.36 (range, 1-5). The overall rate of PVR was 13 of 213 eyes (6.1%). In patients with VH, the rate of PVR was 2 of 24 eyes (8.3%), and in eyes without VH, it was 11 of 189 eyes (5.8%) ( $P=.64$ ). The retina was attached in 212 eyes (99.5%), with 1 eye having a new asymptomatic inferior RD that was walled off with laser.

## COMMENT

Pneumatic retinopexy is an in-office procedure for repair of RD with certain characteristics. In the literature, it has a single-operation success rate of 74.4% with a range of 43.75% to 93.55%.<sup>5</sup>

Previous reports by Grizzard et al<sup>6</sup> and Kulkarni et al<sup>7</sup> found that male sex was a statistically significant factor in successful outcome of PR. Both advocated that better patient education about adherence to positioning may eliminate this discrepancy. In our study, there was no difference attributed to sex, because men and women had almost identical success rates (64.9% and 64.6%, respectively).

Several previous reports indicate decreased success rate in patients with pseudophakic and/or aphakic eyes when compared with patients with phakic eyes.<sup>2,3,6,8-12</sup> In our series, although patients with phakic eyes had a higher success rate (67.5%) when compared with patients with pseudophakic eyes (57.1%), this did not reach statistical significance. There were fewer patients in the pseudophakic group ( $n=56$ ) when compared with the phakic group ( $n=157$ ), and this may contribute to the lack of statistical significance.

The presence of VH in our series had a significant impact on outcome and success of PR. Because the surgeons adhered to the guidelines of having sufficiently clear media to rule out additional retinal breaks, this result indicates that even a small amount of VH may obstruct hidden breaks or other significant pathology. Seven (53.8%) of 13 eyes with VH in which PR failed had new breaks, 3 (23%) of which were inferior. The overall rate of PVR in our study was 6.1%, which is lower than previous reports for both PR and SB.<sup>10,11</sup> In eyes with VH, 2 of 24 (8.3%) developed PVR while 11 of 189 eyes (5.8%) without VH developed PVR ( $P=.64$ ). There are mixed data

**Table 3. Nonsignificant Characteristics Affecting Outcome<sup>a</sup>**

Characteristic	Success Rate, No./Total No. (%)	P Value
Male	74/114 (64.9)	.97
Female	64/99 (64.6)	
Left eye	58/92 (63.0)	.64
Right eye	80/121 (66.1)	
Phakic	106/157 (67.5)	.16
Pseudophakic	32/56 (57.1)	
PVD	85/135 (63)	.46
No PVD	53/78 (67.9)	
Macula on	92/137 (67.2)	.33
Macula off	46/76 (60.5)	
Presenting VA $\geq$ 20/50	85/126 (67.5)	.33
Presenting VA $<$ 20/50	53/87 (60.9)	
Lattice degeneration	20/35 (57.1)	.30
No lattice	118/178 (66.3)	
No. of retinal breaks		
1	111/169 (65.7)	.59
>1	27/44 (61.4)	

Abbreviations: PVD, posterior vitreous detachment; VA, visual acuity.

<sup>a</sup>Presenting clinical characteristics that did not have a statistically significant impact on the successful outcome of pneumatic retinopexy.

in the literature regarding presence of preoperative VH and the development of PVR. One report found no association of PVR with presence of mild preoperative VH<sup>13</sup>; however, other reports suggest severe VH may lead to PVR after primary RD repair.<sup>14,15</sup> In our series, the presence of VH did not increase the risk of PVR. Given the retrospective nature of the study, it is impossible to specifically grade the amount of VH; however, from the documentation, it generally ranged from only red blood cells present in the vitreous to a small amount of preretinal hemorrhage. These findings may suggest that caution should be exercised when considering PR for a detachment with VH. Lattice degeneration, presence of PVD, and macular status did not have any impact on the successful outcome of PR in our study.

The number of breaks (1 vs more than 1) did not have an impact on the success rate of PR. All breaks in this series were located in the superior 8 clock hours of the fundus. Most breaks were also within a single clock hour except for a few cases ( $n=15$ ). In these eyes, there was a lower success rate (53.3% vs 65.7%), but this was not statistically significant. The small number of patients in this group may be the reason for lack of significance.

Grizzard et al<sup>6</sup> showed that PR had a lower success rate in larger RDs, specifically those involving 4 quadrants or total RD. In our series, we also found that an increase in the number of clock hours of RD was negatively associated with the success rate of PR ( $P=.01$ ). The clock hour point where significance was reached was 4.5 clock hours of RD. In our study, 18 of 21 (85.7%) of these eyes had new or possibly missed breaks. Eight (38%) of these were inferior. The other 3 eyes had persistent or increased subretinal fluid.

The mean preoperative VA between the success group and the failure group was identical (logMAR 0.70) and was not associated with the success of the procedure. Overall final VA was 20/40; 72.3% of patients achieved a final VA of 20/40 or better. Final VA was significantly better in patients with a successful PR than those with a failed PR (20/30

and 20/60, respectively;  $P < .001$ ). Of patients with a successful PR, 84.8% achieved a VA of 20/40 or better, while 52.0% of patients requiring an additional procedure(s) achieved a VA of 20/40 or better. These results are similar to a previous report of 302 cases, which found patients with single-operation success achieved a VA of 20/40 or better 86% of the time and patients requiring additional procedures achieved a VA of 20/40 or better 52% of the time ( $P < .001$ ).<sup>11</sup> Other studies have also found worse VA outcomes in patients requiring additional procedures in both PR and SB.<sup>10,16,17</sup> In our series, similar to the reported studies, patients who required fewer procedures achieved better visual results.

When looking at final VA with respect to the macular status on presentation, others have found visual outcomes after PR to be similar to SB.<sup>7,10</sup> Overall, patients with macula-on RD achieved a mean final VA of 20/30, with 78.8% of patients having a final VA of 20/40 or better. The mean final VA of patients with macula-off RD was 20/50 and 63.2% had a VA of 20/40 or better. In patients with a successful initial PR, 90.2% of patients with macula-on RD and 73.9% of patients with macula-off RD achieved a final VA of 20/40 or better, with a mean final VA of 20/30 in both groups. In patients requiring more than 1 procedure, the results were less favorable, with 55.6% of patients with macula-on RD and 46.7% of patients with macula-off RD achieving a final VA of 20/40 or better, with a mean final VA of 20/50 and 20/100, respectively. These findings agree with previous reports of PR as well as SB that also found that patients with macula-on RD had better VA outcomes than patients with macula-off RD.<sup>11,17</sup> In the 2-year follow-up of the multicenter trial comparing PR with SB, it was also found that patients, whether they had macula-on or macula-off RD, tended to have better VA outcomes if success was achieved with a single operation, whether it was a PR or SB, and patients with macula-on RD tended to have better final VA outcomes.<sup>8</sup> Retinal reattachment was achieved in nearly all of our patients (212 of 213 patients). One patient had a new inferior asymptomatic detachment that was walled off with laser retinopathy.

This study is limited by its retrospective nature. The procedure and recording were performed by multiple surgeons, which may limit the accuracy of the documentation. The small number of patients in some groups may have limited the statistical analysis. The success rate of this study is lower than the previous report from our center.<sup>18</sup> This may be due to both the longer inclusion period as well as reviewing all the medical records coded with PR, rather than those with PR with an additional retinal reattachment procedure.

Despite these limitations, our study confirms that PR is a viable option for certain patients with RD. In a Medline search, this is one of the largest series evaluating the preoperative characteristics and outcomes of PR. In patients with VH and larger detachments (greater than 4.5 clock hours), the success rate may be lower. Sex, lens sta-

tus, presence of PVD or lattice degeneration, macular status, and the number of retinal breaks did not adversely affect the success rate in our study. Final visual acuity, regardless of presenting VA or macular status, is better with successful reattachment with a single procedure.

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